ProjD: Project Description (attachment 4)
Real-time Groundwater Level Monitoring Network

Background:
The Yolo County Flood Control District (District), covering more than 190,000 acres in Western Yolo County, has a 160 mile long network of canals that are left unlined as part of official District policy. Historically, this policy has allowed 25 to 50 percent (depending on year type) of surface water deliveries to recharge the underlying aquifer. Recharged water is recovered by the District's farmers and the cities of Davis, Winters and Woodland, without any active management by the District. Now, the District is working with its agricultural water users, and neighboring cities to develop and promote an active management conjunctive water use program.

The District proposes using this AB303 funding opportunity to develop a publicly available ***"real-time groundwater level monitoring network"*** to assist in developing additional technical knowledge of aquifer behavior, as well as to serve as an innovative public education tool to help promote understanding and acceptance of its active conjunctive use program.

Project Description:
The District has been monitoring the region's groundwater on a spring/fall basis for over 60 years. Over the last decade, the District has developed a range of publicly available groundwater management tools such as; a water resources information database (WRID), a county-wide groundwater model (IGSM), and tri-annual subsidence reports. Additionally, since 2005, the District has been implementing a long-term strategy of deploying a region-wide remote monitoring system (SCADA) to track a variety of surface water, groundwater and environmental parameters. All of these efforts have been in support of the District developing a regional "active management" conjunctive use program. This conjunctive use program is designed to preserve, protect and utilize the region's groundwater resource.

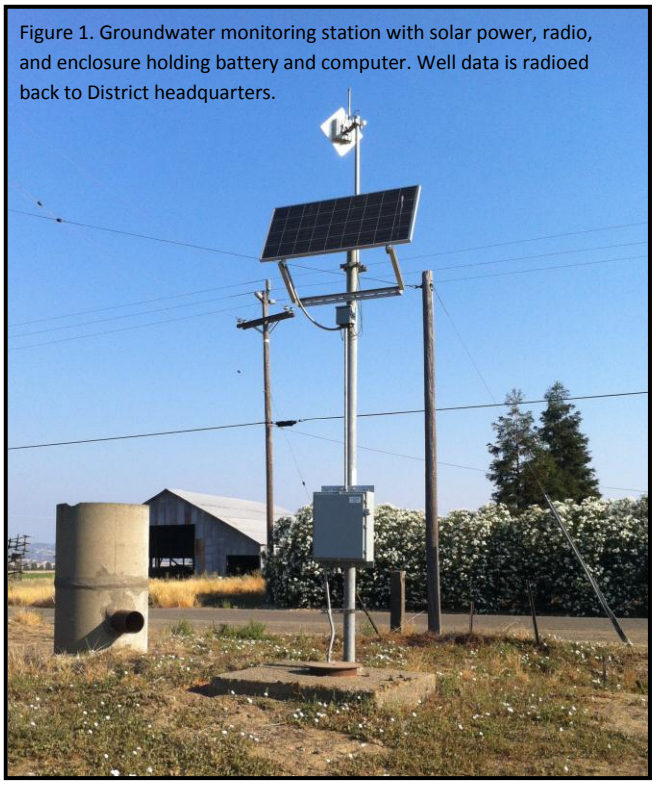
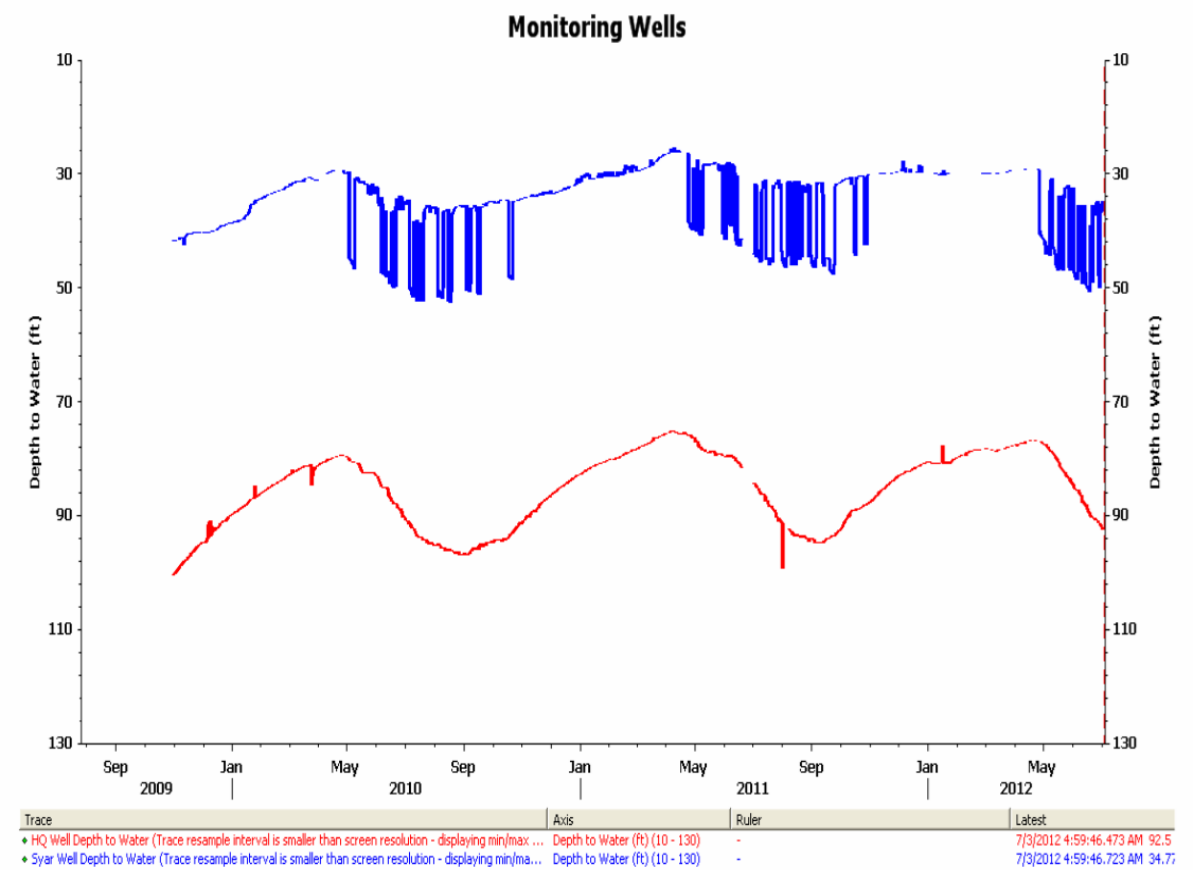


Figure 1. Groundwater monitoring station with solar power, radio, and enclosure holding battery and computer. Well data is radioed back to District headquarters.

An exciting development that has taken place at the District over the last three years is the deployment of continuous recording groundwater level sensors. The District currently has deployed, on a trial basis, six real-time groundwater level sensors throughout its service area (a picture of one of the installed sensors is shown in figure 1). These sensors, connected to the District's SCADA system, provide a real-time view and insight into groundwater interactions including; the rate of increase and decrease

of seasonal groundwater levels, canal seepage, stream and groundwater connectivity, and impacts of nearby groundwater pumping on other wells. The hydrographs generated by these sensors (two example hydrographs are shown in figure 2) also provide a valuable public education tool. Besides the insights and knowledge noted previously, the data provides an irrefutable graphic of groundwater dynamics at particular locations and times in the system. This information establishes credibility for the District with its water users and the public. This credibility allows the District to develop its active conjunctive use program, and provides local landowners with confidence that any negative (or positive) impacts due to District groundwater pumping will be observed, documented, and mitigated.

Figure 2. Hydrographs from real-time groundwater level sensors as displayed in the District's SCADA system.



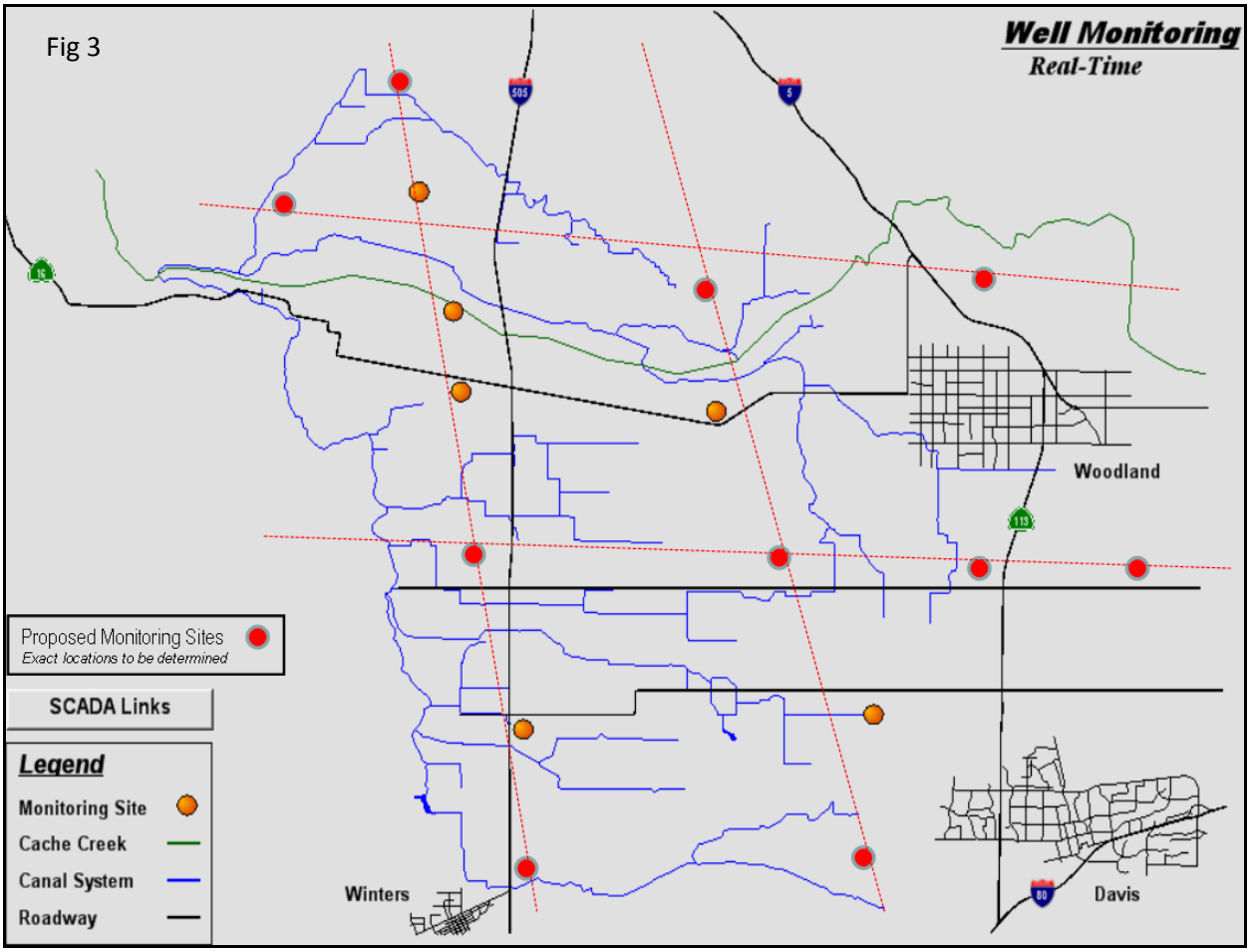
The District proposes to use this AB303 grant to accomplish three primary tasks to establish a regional real-time groundwater level monitoring network. These tasks include;

i. The installation of approximately ten additional real-time groundwater remote terminal units (RTUs) that include water level sensors throughout its service area (figure 3. shows the location of the District's six existing real-time monitoring stations, as well as general distribution of the ten proposed sensor stations),

ii. The establishment of a publicly accessible web-site that will allow for real-time posting and viewing of collected monitoring data, and

iii. The analysis of the data in order to gain insight into the region's groundwater behavior and to guide the further development of the District's active management conjunctive use program. The analysis of the data will include the establishment of an appropriate "multi-station groundwater level index". This index, whereby an annual calculation will be made relative to a determined baseline level, will provide the local public a general sense of groundwater conditions in a similar manner to which they use reservoir storage and snowpack to forecast surface water conditions.

Figure 3. Map of current and proposed real-time groundwater monitoring sites.



Project Goals and Objectives:
The establishment of this real-time groundwater level monitoring network supports the District's groundwater management plan (GWMP) goals and objectives. The GWMP includes basin management objectives on page 1. A more detailed description of the basin management objectives is presented on pages 12 through 17 of the GWMP. The primary goal of the GWMP to *"maintain and enhance local groundwater quantity and quality, resulting in a reliable groundwater supply for beneficial uses and avoidance of adverse subsidence"* is directly supported by this program. This proposed real-time groundwater level monitoring network will provide definite and achievable quantities of foundational data, on which the District and its regional partners can make appropriate planning decisions. Specific objectives supported by this program include;

- Increase hydrologic data relevant to conjunctive use opportunities
- Minimize the long-term drawdown of groundwater levels
- Facilitate groundwater replenishment and cooperative water management projects
- Support the IRWMP foundational actions program
- Work collaboratively with and understand the goals and objectives of entities engaged in groundwater management in surrounding areas
- Develop innovative and cost effective techniques with which to monitor the status of the groundwater basin

Quality and Usefulness of Information (long term need):
From the experience gained from the installation of the six trial sensors, it is clear that the information collected is of high quality, reliable and tremendously useful. What differentiates this groundwater level data from the bi-annual or even monthly traditionally collected is its continuous and real-time quality. By being able to examine the data at any time, it allows the groundwater manager or researcher to relate specific changes in groundwater elevations to specific events such as Cache Creek winter storm water flows, filling up and emptying of canals at the beginning and ends of irrigation seasons, the effect of adjacent groundwater wells being used, and the effect of seasonal flows in Yolo County's natural slough system. By expanding the real-time groundwater monitoring network beyond the initial six sensor locations, a more thorough understanding of seasonal and long-term behavior of the regions groundwater will be obtained. As noted above, the third task of this program includes developing an appropriate "multi-station groundwater level index". This index will serve as an effective public education tool to alert the public and all interested parties to the relative condition at any given time, from now into the future.

Collaboration with Other Agencies:
The District has a long history of collaboration with both agricultural and urban water resource managers, as well as non-profit and non-governmental agencies. The District, while primarily a provider of water for agricultural purposes, has three of four Yolo County cities; Davis, Woodland and Winters, located within its service area. These cities and the District's agricultural water customers, utilize and help manage a common groundwater basin. More regionally, the groundwater interests of Yolo County are articulated in the Yolo County IRWMP (adopted 2007) and are managed by the WRA Technical Committee and its groundwater subcommittee (on which the District serves as the lead agency). Planning is underway for incorporating these Yolo County groundwater interests into the expanded, 5-county (Lake, Napa, Colusa, Solano and Yolo) Westside IRWM region.

The District has shared and reviewed the initial collected data and methodology with its various partners in the Water Resources Association of Yolo County (WRA), the members of the Northern California Water Association (NCWA), selected San Joaquin Valley water districts (such as the Kings River Water Conservation District and the Kaweah Delta Water Conservation District), at a Department of Water Resources (DWR) Integrated Regional Water Management conference (May 24, 2011), with the UC Davis Watershed Science Center, and with various local non-government environmental organizations such Tuleyome and Audubon California. Letters of support for this proposal are included in attachment 4. This sharing of data and methodology will be undoubtedly be continued and expanded as data from the expanded network becomes available.

Continued Implementation (ongoing use and funding after the grant):
If this real-time monitoring network is funded, the continued implementation, maintenance and quality control of both the equipment hardware and the website after the term of the grant has expired, will be incorporated into both the District's annual budget, and the WRA's regional groundwater program. In the case of the hardware maintenance and support, all costs will be incorporated into the District's ongoing SCADA program. The cost of maintaining the sites is extremely minimal in comparison to the cost of establishing them. Since the District already has trained staff to maintain its SCADA system and the initial six monitoring sites, no further staffing will be required. In the case of the publicly accessible web-site, the minimal fees associated with hosting and maintaining it will be incorporated into the WRA groundwater program which is funded by membership dues. As regards to the continued evaluation of collected data and the adaption of the monitoring program as new information and insights are gained, as noted previously, the WRA Technical Committee is an established and effective mechanism for reporting and evaluating all relevant regional groundwater data and programs.

WrkPln Work Plan: attachment 5
Real-time Groundwater Level Monitoring Network

The geographic scope, maps, specific purpose, goals and objectives of the proposed project are described in the previous section, *Project Description (attachment 4)*. The specific purpose, goals, and objectives related to groundwater management and implementation of the GWMP and IRWMP are also described in the previous section *Project Description (attachment 4).* However, for ease of use in the BMS system, they are also repeated here.

Project Purpose, Goals, and Objectives:
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Proposed Tasks
Tasks for the proposed Real-time Groundwater Level Monitoring Network project include:

- Task 1: Installation of approximately ten additional real-time groundwater remote terminal units (RTUs) that include water level sensors strategically located on two east-west and two north south transects through its service area.
  - Review and refinement of site selection criteria
  - Evaluate and prepare budgets for approximately ten wells for monitoring
  - Prepare and manage well owner agreements
  - Enroll selected wells into the project
  - Procure hardware for installation
  - Install and configure hardware for remote groundwater level sensing

- Commission site including manual quality control procedures
- Configure SCADA software to accept and display incoming data
- Document and prepare a final installation report including an inventory of equipment used, labor budget, and photo documentation of installed sites

- Task 2: Establishment of a publicly accessible web-site that will allow for real-time posting and viewing of collected monitoring data (dissemination of data to the public, stakeholders, agencies, and other interested parties).
  - Define technical requirements of desired website (including the ability to "push" data from a secure SCADA environment, to a public access environment)
  - Refine and sign contract with website developer
  - Work with contractor to develop the look and feel of the new website
  - Commission and maintain new website
  - Prepare a final website development report

- Task 3: Analysis of the data in order to gain insight into the region's groundwater behavior and to guide the further development of the District's active management conjunctive use program. The analysis of the data will include the establishment of an appropriate "multi-station groundwater level index".
  - In coordination with the WRA Technical Committee, District staff will on at least a bi-monthly period formally document their observations from the real-time data. Special attention will be paid to specific events such as charging up of the canal system, groundwater pumping in near proximity to site locations, and winter flows in Cache Creek.
  - At the end of the first and second year of the program, the District will host a "data review" meeting among all interested parties to review District staff's findings and observations. These meetings will be documented in both the first year and end of project reports.
  - Working with local groundwater managers as well as expert consultants, the District will lead the development of a "multi-station groundwater level index". Consideration and weight will be given to those site locations that are determined to show a more representative view of the underlying aquifer.

Strategy for evaluating progress and performance

At the end of each quarter, the status of each task and sub-task will be compared to the proposed budget and schedule (table 2 and table 4). Each task and sub-task will be evaluated if it is on schedule and on budget. If so, the project will be considered making good progress and performance and this will be reported in the grant report. If certain tasks are falling behind, the strategy will be adjusted and this will also be reported. Minor adjustments include adjusting the schedule, adding more staff time, or asking for help from the water community or DWR. Major adjustments in strategy are not anticipated at this time, but will be fashioned to respond to specific conditions as they arise.

Access to private property

The District has a long history of access to private property (within the District) for the purpose of monitoring groundwater. Starting in the 1950's and continuing today, District staff visit 165 private wells each spring and fall to measure groundwater levels. This group of 165 volunteer landowners is our base group to ask for additional participation in other studies, such as groundwater quality monitoring. Recently, participants have allowed the District access to 25 private wells for one study from 2004 to 2007 and for another study in 2011 we gained access to 20 wells. The participation from the 2004-2007 water quality study is presented below (Table 1). In general, Yolo County landowners recognize the importance of groundwater and are willing to participate in monitoring programs, such as our proposed Real-Time Network.

Table 1. Response from Letter to Well Owners Currently Participating in the District Water Level Monitoring Program Requesting Permission to Sample for Water Quality

Description	Number	Percentage
No response	67	47%
Responded positively, would like to participate	69	48%
Undecided	3	2%
Does not want to participate	2	1%
Wells not useable for water quality sampling	2	1%
Total letters sent requesting permission to sample	143	100%

Additional wells not in the District water quality sampling network that are willing to participate (i.e., located in areas of interest to the study)	21
District water level network wells willing to participate	69
Total number of well owners willing to participate	90

CEQA and environmental compliance

The District is committed to compliance with all environmental laws and regulations, including the National Environmental Policy Act (NEPA), the California Environmental Quality Act (CEQA) and other environmental requirements, such as the state and federal Endangered Species Acts, Sections 401 and 404 of the federal Clean Water Act and the National Historic Preservation Act.

The tasks to be conducted under the proposed project constitute basic data collection and resource evaluation activities that will not result in serious or major disturbances of

environmental resources. Monitoring and assessment are generally categorically exempt under NEPA and CEQA.

Project deliverables

1. A publicly accessible website displaying real-time groundwater level data for the area.
2. Quarterly Progress Reports.
3. Final Report including description and guide to the “multi-station groundwater level index”

BUDGET Budget: attachment 6
Real-time Groundwater Level Monitoring Network

The main budget is presented in Table 2. District labor was estimated using estimates of days to completion and the costs for each day. The budget for hardware was based on the individual cost of each station, as constructed by the District previously and described in table 3. The cost of creation of the publicly accessible website, with secure data network connections to the District SCADA system, was based on submission of a draft scope of work and contract from a local engineering consultant specializing in web and map based database development.

Table 2. Main Project Budget

Budget Category	Non-State Share* (Funding Match)	Requested Grant Funding	Total
Task 1. Installation of approximately ten additional (16 total) real-time groundwater			
Review and refinement of site selection criteria	$3,000		$3,000
Evaluate and prepare budgets for wells	$2,000		$2,000
Prepare and manage well owner agreements	$5,500		$5,500
Enroll selected wells into the project	$8,000		$8,000
Procure hardware for installation		$75,970	$75,970
Install and configure hardware for remote groundwater level sensing		$60,000	$60,000
Commission site including manual quality control procedures		$20,000	$20,000
Configure SCADA software to accept and display incoming data		$15,000	$15,000
Task 2. Establishment of a publicly accessible web-site that will allow for real-time posting of data.			
Define technical requirements of desired website (including the ability to "push" data from a secure SCADA environment, to a public access environment)		$2,500	$2,500
Refine and sign contract with website developer		$1,000	$1,000
Work with contractor to develop the new website		$40,180	$40,180
Commission new website		$2,000	$2,000
Prepare a final website development report		$4,000	$4,000
Task 3. Analysis and establishment of an appropriate "multi-station groundwater level index".			
Bi-monthly, formally document observations (such as charging up of the canal system, groundwater pumping in near proximity to site locations, and winter flows in Cache Creek).	$3,500	$5,000	$8,500
Host a "data review" meeting to review District staff's findings and observations	$2,000	$4,000	$6,000
Development of algorithm for "multi-station groundwater level index".	$8,000	$10,000	$18,000
			Grand Total
Total (Sum the rows for each column)	$32,000	$239,650	$271,650

*Consists of local, federal, and value of in-kind service; this value should correspond to the BMS values under Applicant Information and Question's Tab, Budget (BMS fields require a breakdown of non-state share costs, if applicable).

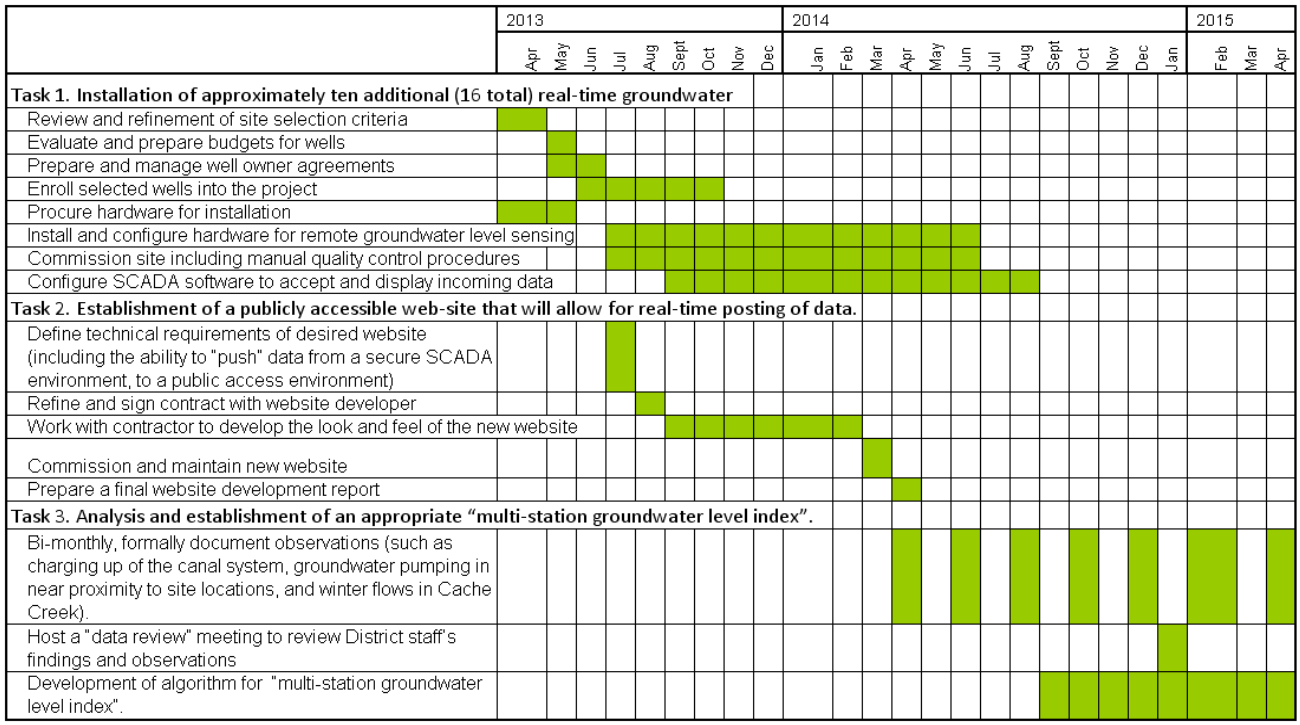
Table 3. Hardware costs for an individual real-time groundwater level monitoring station.

Item Description	Quantity	Price	Extended
SCADAPack 350	1	$1,600	$1,600
Radio Mast Parts	1	$150	$150
4.9 GHz Radio	1	$500	$500
Radio POE Module	1	$40	$40
POE Power Plug	1	$5	$5
Outdoor Cat-5	25	$1	$25
Disconnect Terminal Block	10	$8	$82
Terminal Block	10	$4	$40
Grounding Terminal Block	5	$7	$35
1.25" Fuse Block	5	$9	$46
Larger Fuse Bock	2	$10	$20
End Bracket Block	4	$2	$8
Control Relays DPDT 12VDC	2	$20	$40
Control Relay Bases	2	$10	$20
Control Relay RC Surge Suppressor	2	$8	$16
DIN Rail	1	$10	$10
Wire Ducting	1	$50	$50
Panel Wire	1	$50	$50
Pole with base	1	$150	$150
Panel 24"x20"	1	$75	$75
Enclosure 24"x20"x8"	1	$600	$600
Enclosure 6"x6"x4"	1	$55	$55
Surge Supressor	1	$175	$175
Water Level Sensor	1	$600	$600
140 Watt Solar Panel	1	$650	$650
Solar Panel Mount	1	$305	$305
Solar Charge Controller	1	$175	$175
108 Amp Hr Battery	1	$300	$300
Ground Rod	1	$20	$20
Ground Rod Clamp	1	$10	$10
Ground Wire Clamp	1	$5	$5
Ground Buss	1	$15	$15
Ground Wire	25	$1	$25
Conduit and Fittings	1	$200	$200
Hardaware Total			**$6,097**
Panel Fabrication (Sierra Controls)			**$1,500**
Total			**$7,597**

SCHED Schedule: attachment 7
Real-time Groundwater Level Monitoring Network

The project schedule below (Table 4), was derived for Task 1 from the experience of already installing six real-time monitoring wells. Task 2 schedule (development of the website) of six months was confirmed as appropriate with the engineering consultant. The development time needed for the multi-station index was based on other similar projects completed by the District (Task 3).

Table 4. Schedule of tasks for the proposed *Real-Time Monitoring Network.*



Readiness to proceed when funding becomes available

The District has spent the last 5 years building its wireless SCADA network in Yolo County. The database server software, radio communications backbone, and in-house expertise have all been developed while building the canal monitoring portion of the system. Today, we are ready to build and connect the real-time well monitoring stations to our system.

Additionally, the District has operational reserves that can cover the cash-flow needs of this proposed project. As of May 31, 2012 the District's cash balance of cash plus investments is $5,074,441.